AMENDMENT TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

LISTING OF CLAIMS

1 – 4 (cancelled)

5. (currently amended) A method of decoding a two-dimensional symbol matrix comprising the steps of:

acquiring an image of an object;

pre-processing said image to obtain a first filtered image and a second filtered image, wherein said first and second filtered images are obtained using different filters; and

evaluating each of said first and second filtered images for a valid symbol, the evaluating step comprising the steps of;

defining one of said first and second filtered image as a current image;

locating at least one coarse location within said current image that appear to contain a symbol shape to determine a set of symbol candidate locations, the locating step comprising the steps of:

~~The method of claim 4 in which said step of locating at least one coarse location further comprises the steps of:~~

measuring a first and second derivative of image intensity values across said image; and

identifying areas of said image in which said first and second derivatives correspond to areas approximating predetermined shape and size parameters of said two-dimensional symbol;

whereby information for each such identified area comprises a location and an orientation;

refining at least one of said symbol candidate locations to obtain a refined symbol image;

evaluating said refined symbol image by decoding to determine if it corresponds to a valid symbol; and

if said symbol image fails to correspond to a valid symbol, then repeating said steps of locating, refining and

evaluating after having redefined said current image to contain said second filtered image.

6. (original) The method of claim 5 in which said step of identifying areas further comprises the steps of:

filtering the results of said measuring step to remove from further consideration any areas of said image that fail to meet predetermined threshold criteria selected from the set of size, shape, orientation, and location.

7. (cancelled)

8. (currently amended) A method of decoding a two-dimensional symbol matrix comprising the steps of:

acquiring an image of an object;

pre-processing said image to obtain a first filtered image and a second filtered image, wherein said first and second filtered images are obtained using different filters; and

evaluating each of said first and second filtered images for a valid symbol, the evaluating step comprising the steps of:

defining one of said first and second filtered image as a current image;

locating at least one coarse location within said current image that appear to contain a symbol shape to determine a set of symbol candidate locations, the locating step comprising the steps of;

refining at least one of said symbol candidate locations to obtain a refined symbol image, the refining step comprising the steps of;

performing a variance-based analysis of each of said at least one symbol candidate locations, the variance-based analysis comprising the steps of;

~~The method of claim 7 in which said variance based analysis further comprises the steps of:~~

dividing each symbol candidate location into a plurality of zones;

calculating an intensity variance for each of said zones; and

calculating a variance of a sum of the variances for each of said plurality of zones; whereby a single variance value is determined for each candidate location; and

reducing said set of symbol candidate locations according to whether a variance calculation for a candidate location exceeds a predetermined threshold;

evaluating said refined symbol image by decoding to determine if it corresponds to a valid symbol; and

if said symbol image fails to correspond to a valid symbol, then repeating said steps of locating, refining and evaluating after having redefined said current image to contain said second filtered image.

9. (cancelled)

10. (currently amended) A method of decoding a two-dimensional symbol matrix comprising the steps of:

acquiring an image of an object;

pre-processing said image to obtain a first filtered image and a second filtered image, wherein said first and second filtered images are obtained using different filters; and

evaluating each of said first and second filtered images for a valid symbol, the evaluating step comprising the steps of;

defining one of said first and second filtered image as a current image;

locating at least one coarse location within said current image that appear to contain a symbol shape to determine a set of symbol candidate locations, the locating step comprising the steps of;

refining at least one of said symbol candidate locations to obtain a refined symbol image;

evaluating said refined symbol image by decoding to determine if it corresponds to a valid symbol, the step of evaluating said refined symbol image comprising the steps of;

performing a generic refinement on said refined symbol to obtain a refined location of a plurality of locator patterns of said symbol candidate, the step of performing a generic refinement comprising the steps of;

~~The method of claim 9 in which said generic refinement further comprises the steps of:~~

determining a set of two-dimensional areas within said refined symbol candidate, each

said two-dimensional area being located and oriented to contain 2D image information corresponding to a locator pattern of a symbol;

evaluating said 2D image information to determine a preliminary refined location where said corresponding locator pattern begins and ends; and

interpolating said preliminary refined locations obtained from two-dimensional areas corresponding to adjacent locator patterns of said symbol to determine a secondary refined location where each said locator pattern of said symbol begins and ends;

then performing a symbology-specific refinement; and

then decoding the result of said symbology-specific refinement; and

if said symbol image fails to correspond to a valid symbol, then repeating said steps of locating, refining and evaluating after having redefined said current image to contain said second filtered image.

11. (currently amended) A method of decoding a two-dimensional symbol matrix comprising the steps of:

acquiring an image of an object;

pre-processing said image to obtain a first filtered image and a second filtered image, wherein said first and second filtered images are obtained using different filters; and

evaluating each of said first and second filtered images for a valid symbol by decoding, wherein said second filtered image is not evaluated unless said first filtered image fails to result in a successful evaluation, the evaluating step comprising the steps of

defining one of said first and second filtered image as a current image;

locating at least one coarse location within said current image that appear to contain a symbol shape to determine a set of symbol candidate locations;

refining at least one of said symbol candidate locations to obtain a refined symbol image;

evaluating said refined symbol image by decoding to determine if it corresponds to a valid symbol, the step of evaluating said refined symbol image comprising the steps of;

performing a generic refinement on said refined symbol to obtain a refined location of a plurality of locator patterns of said symbol candidate;

then performing a symbology-specific refinement comprising the steps of;

~~The method of claim 9 in which said step of performing a symbology-specific refinement further comprises the step of:~~

selecting a model symbol from a predetermined set of model symbols;

evaluating said plurality of locator patterns according to said model symbol, to determine which of said locator patterns corresponds to a symbol-specific finder pattern inherent in said model symbol; and

refining said symbol candidate by orienting said symbol candidate according to a predefined location of said finder pattern in said selected model symbol; and

then decoding the result of said symbology-specific refinement; and

if said symbol image fails to correspond to a valid symbol, then repeating said steps of locating, refining and evaluating after having redefined said current image to contain said second filtered image.

12. (original) The method of claim 11 in which said step of evaluating further comprises the steps of:

counting the number of light intensity peaks occurring along an axis of each of said locator patterns;

comparing the number of said peaks in each respective locator pattern with a number of peaks expected according to said model pattern; and

determining which of said locator patterns corresponds to each locator pattern according to said model pattern.

13 – 14 (cancelled)

15. (currently amended) A method of decoding a two-dimensional symbol matrix marked on an object comprising the steps of:

acquiring an image of an object;

pre-processing said image to obtain a morphed image and a non-morphed image;

locating a set of at least one coarse location of a symbol image candidate in said morphed image;

filtering said set to discard any coarse location that fails to meet predetermined selection criteria selected from the set of location, orientation and size;

decoding image information within any remaining coarse location according to a symbology-specific decoding method comprising the steps of;

~~The method of claim 13 in which said step of decoding image information further comprises the step of:~~

dividing each said coarse location into a plurality of zones;

calculating an intensity variance for each of said zones;

calculating a variance of a sum of the variances for each of said plurality of zones; whereby a single variance value is determined for each coarse location; and

discarding any coarse location having a single variance value less than a predetermined threshold;

defining a refined location of a symbol candidate by processing each remaining coarse location to determine a set of locator patterns within said coarse location;

orienting each refined location according to said set of locator patterns with respect to a selected symbol model defining locator patterns; and

interpreting information in a data region of said symbol candidate according to said orientation, and said locator patterns with respect to said selected symbol model;

evaluating whether said decoding produced a valid result; and

if not, then repeating said steps of filtering, decoding and evaluating using said non-morphed image;

whereby said symbol matrix is either decoded or said object is rejected as not having an observable and decodable symbol.

16. (cancelled)

17. (currently amended) An apparatus for decoding a two-dimensional symbol matrix comprising:

an image acquisition device for obtaining an image of an object; and

a processor for pre-processing said image to obtain a first filtered image and a second filtered image, wherein said first and second filtered images are obtained using different filters; and

evaluating each of said first and second filtered images for a valid symbol by decoding, wherein said second filtered image is not evaluated unless said first filtered image fails to result in a successful evaluation, the processor comprising:

~~The apparatus of claim 16 in which said processor further comprises:~~

a morphology filter for creating said first filtered image;

a coarse location processor for determining a set of coarse locations of symbol candidate information in said image;

a generic filter for removing from said set any coarse locations that fail to meet predetermined criteria selected from the set of size, location, and orientation;

a variance filter for removing from said set any coarse locations having an intensity variance less than a predetermined threshold;

a refinement processor for determining the specific location of image information corresponding to predetermined locator patterns according to a model image selected from a set of model images;

an orientation processor for identification of a symbol orientation according to said information corresponding to predetermined locator patterns;

a symbol decoder for decoding data region information in said image; and

a symbol evaluator to determine if said decoded symbol is a valid symbol.